REMARKS

Applicants appreciate the Examiner's thorough consideration provided in the present application. Claims 1-13 are now present in the application. Claim 1 has been amended. Claim 1 is independent. Reconsideration of this application, as amended, is respectfully requested.

Interview With The Examiner

A telephone interview was conducted with the Examiner in charge of the above-identified application on April 1, 2009. Applicants greatly appreciate the courtesy shown by the Examiner during the interview.

In the interview with the Examiner, Applicants presented proposed amendments to the claims and arguments with regard to the rejection under 35 U.S.C. § 102 with regard to independent claim 1. Applicants also presented the clarification on deadlock-free mechanism during the interview. In this Reply, Applicant has amended independent claim 1 for the Examiner's further consideration.

Rejection Under 35 U.S.C. § 112, 1st Paragraph

Claim 1 stands rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. This rejection is respectfully traversed.

As the Examiner will note, claim 1 has been amended to remove the recitation of "without dropping data packets" to address the Examiner's rejection. Also, claim 1 has been amended to more clear clarify the present invention which is directed to a method for transitioning (or altering) of a network routing function such that the transitioning action is controlled by means of tokens (which are not switch labels) defining the new routing function to be used by each network element in the network to ensure that forwarding of data packets will not be halted indefinitely (i.e., reaching a state of network deadlock), as recited in claim 1.

Accordingly, claim 1 now complies with the written description requirement.

Reconsideration and withdrawal of the rejection under 35 U.S.C. § 112, first paragraph, are therefore respectfully requested.

Claim Rejections Under 35 U.S.C. §§ 102 and 103

Claims 1-6 and 8-13 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Khosravi, U.S. Patent No. 7,200,146. Claim 7 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Khosravi in view of Oprescu, U.S. Patent No. 5,784,557. These rejections are respectfully traversed.

A complete discussions of the Examiner's rejections are set forth in the Office Action, and are not repeated herein.

Without conceding to the propriety of the Examiner's rejection, but merely to timely advance the prosecution of the application, as the Examiner will note, independent claim 1 has been amended to more clearly define the present invention over the references relied on by the Examiner.

In particular, independent claim 1 now recites "A method for *transitioning a network routing function in a network from a first routing function* R_{old}, defining an established set of possible connections for forwarding data packets between a plurality of communication input ports $I_1,..,I_n$ and output ports $O_1,..,O_m$ of each network element in said network, to a second routing function R_{new}, defining a new set of possible connections between said input and output ports of each network element, *wherein the transitioning of said network routing function is controlled by means of tokens defining said second routing function* R_{new} *to be used by each network element in the network to ensure that forwarding of data packets in the network elements in said network will not be halted indefinitely when altering the network routing function, where said method when applied to a network with link-level flow control will not create network deadlock*, said method comprising: (1) *performing the following sequence of steps for each input port* I_i *of each network element in said network for altering the routing function used by each network element: (1a) applying the first routing function* R_{old} *for input port*

I_i, (1b) receiving a token on input port I_i, (1c) stop forwarding of data packets arriving on port I_i, (1d) applying the second routing function R_{new} for input port I_i, (1e) start forwarding of data packets to every output port O_j associated with input port I_i according to the second routing function R_{new} only if said output port O_j has transmitted a token, (2) *performing the following sequence of steps for each output port O_j, of each network element in said network:* (2a) determining if the token has been received on all input ports I_i associated with output port O_j according to the first routing function R_{old}, (2b) transmitting a token on output port O_j when the token has been received on all said associated input ports I_i." Support for these amendment may be found at least at, for example, Fig. 6 and the corresponding disclosure of the present invention as originally filed. Thus, no new matter has been added. Applicants respectfully submit that the combination of steps set forth in claim 1 is not disclosed or suggested by the references relied on by the Examiner.

Specifically, the present invention is directed to a method for *transitioning a network routing function in a network from a first routing function R_{old},* defining an established set of possible connections for forwarding data packets between a plurality of communication input ports I_1,..,I_n and output ports O_1,..,O_m of each network element in said network, to a second routing function R_{new}, defining a new set of possible connections between said input and output ports of each network element, *wherein the transitioning of said network routing function is controlled* ***by means of tokens*** *defining said second routing function R_{new} to be used by each network element in the network to ensure that forwarding of data packets in the network elements in said network will not be halted indefinitely when altering the network routing function, where said method when applied to a network with link-level flow control will not create network deadlock.* It is noted that the present inventive method as set forth in claim 1 will thus ensure a global coordination of the sequence defining the transition of network routing function when the method is performed in each network element in the network.

With regard to the Examiner's reliance on Khosravi, first, Applicants respectfully submit that the present invention and the Khosravi reference have two completely different objectives. Referring to the abstract, Col. 2, lines 17-18 and Col. 6, lines 42-47 of Khosravi, the objective of

the Khosravi is to speed up routing efficiency (i.e., improve performance) by processing the switch-label using an abbreviated address which is faster than processing a full address. However, by contrast, the objective of the present invention is to **reconfigure the routing function in a deadlock-free manner.** Applicants respectfully emphasize that the switch label of Khosravi cannot be comparable with the token of the present invention. Referring to Col. 5, lines 16-42 of Khosravi, it is clearly defined that the "switch label" in Khosravi serves as a concise *proxy* of an IP address, which is quite different from the purpose and use of "tokens" of the present invention which serves as ***synchronizers*** to globally coordinate the transition from one network routing function to another at each router port, as described on page 4 line 25 through page 6 line 32 of the present Specification. For this reason, Applicants respectfully submit that the present invention as set forth in claim 1 is patentably distinguishable over the teachings of Khosravi.

Further, on page 3 of the Office Action, the Examiner refers to the "update message" of Khosravi as the token of the present invention; Applicants respectfully disagree. In Khosravi, an update message is a message coming into the router from *other* routers running a routing protocol such as RIP or OSPF (see Col. 8, lines 13-28 of Khosravi). As mentioned above, however, the token of the present invention is referring to a synchronizer used to globally coordinate the transition between old and new routing functions to ensure that network deadlock will not form during the transitioning action, which has a totally different function and objective from the "update message" of Khosravi. Therefore, Applicants respectfully submit that the "update message" of Khosravi cannot be equivalent to the tokens of the present invention, and thus fails to teach or suggest the steps of "*(1a) applying the first routing function R_{old} for input port I_i, (1b) receiving a token on input port I_i*" as recited in claim 1.

The Examiner also asserts that Col. 9, Table 2 of Khosravi teaches the step of "*(1c) stop forwarding of data packets arriving on port I_i*" as recited in claim 1; Applicants respectfully disagree. A careful review the Table 2 shown in Col. 9 of Khosravi indicates that the Table 2 of Khosravi merely defines *how* routing tables in forwarding elements (FEs) are updated, but does not disclose *when* updates can occur (i.e., when packet forwarding stops, or not). Also, as clearly

recited in Col. 9 lines 31-44 and 51-56 of Khosravi, the *path* of the packet transfer between the plurality of FEs according to generated/computed switch labels; however, on the contrary, the tokens in the present invention define the *timing* (i.e., *when*, not *how*) of packet transfer between the plurality of ports which is conditioned upon their states, i.e., whether they have already transmitted a token that separates the use of one routing function from another. It is noted that the control of *when* the packet transfer between the plurality of ports happen relative to the use of one routing function from another is decisive for the ability of the present invention to guarantee reconfiguration of the routing function in a deadlock free manner. For this reason, Applicants respectfully submit that Khosravi also fails to teach or suggest "*(1c) stop forwarding of data packets arriving on port I_i,* (1d) applying the second routing function R_{new} for input port I_i, (1e) *start forwarding of data packets to every output port O_j* associated with input port I_i according to the second routing function R_{new} *only if said output port O_j has transmitted a token,*" as recited in claim 1.

In addition, Applicants further submit that the token is not equivalent to a combination of "update message" (asserted by the Examiner on Page 3, line 12-13 of the Office Action) and "switch label table" (asserted by the Examiner on Page 4, line 2-4 of the Office Action). In Khosravi, an update message is a message coming into the router from *other* routers running a routing protocol such as RIP or OSPF (see Col 8, lines 13-28 of Khosravi); and a switch label table is a table communicated to FEs *inside* the router, which is used to forward data packets between FEs *inside* the router in a more efficient way. (see Col 5, lines 16-23 of Khosravi). It is noted that neither the update message received from outside the Router nor the forwarding of switch label tables between FEs inside the Router are taught by Khosravi to contain the element of timing of routing updates and packet transfer that is vital to the present invention. Therefore, Applicants respectfully submit that Khosravi also fails to teach or suggest "(2) performing the following *sequence of steps for each output port O_j*, of each network element in said network: (2a) *determining if the token has been received on all input ports* I_i associated with output port O_j according to the first routing function R_{old}, (2b) *transmitting a token on output port O_j when the token has been received on all said associated input ports I_i*" as recited in claim 1.

Further, as mentioned above, the control of *when* the packet transfer between the plurality of ports happen relative to the use of one routing function from another is decisive for the ability of the present invention to **guarantee reconfiguration of the routing function in a deadlock free manner**. Applicants respectfully explain using the following example of what a network deadlock is, and why it can happen in a reconfiguration from one routing function to another if one does not control *when* packet transfer between the plurality of ports happen. Referring to below Fig. 1, there are four Compute Nodes (CN1 through CN4). Each of the four Compute Nodes is connected to a switch 10. The switches are interconnected through bidirectional links with a channel in each direction. For simplicity, only one unidirectional channel of each link has been included in the drawing. The channels that are illustrated are the ones in the clockwise direction. Each channel has a buffer on the sending side, and a smaller buffer on the receiving side.

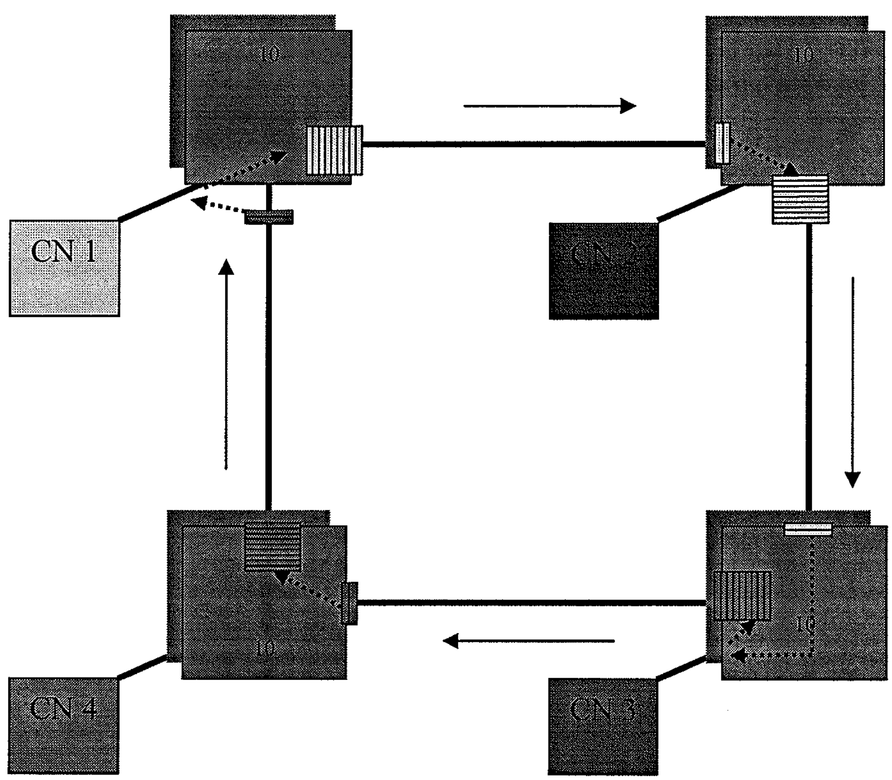

Fig. 1

Assume now that all Compute Nodes send data packets to the Compute Node positioned diagonally opposite itself. Assume also that the old routing function lets all data packets travel horizontally first, and then vertically. Routing packets horizontally first, and then vertically is deadlock free. This is due to the fact that the channel dependency graph is acyclic. The channel dependency graph is the graph where the channels are considered as nodes, and there is a dependency between channel A and channel B if there are packets that according to the routing algorithm will use channel B after channel A. In the figures, the channel dependencies are illustrated by dotted arrows. Note that in figure 1 we only see packets from the CN3 and CN1. This is because the packets from the CN4 and CN2 are directed by the old routing function in the counterclockwise direction. The counterclockwise channels are not illustrated.

Assume now that the network reconfigures to a new routing function *without* controlling the timing of packet transfer between the ports, nor the timing of alteration of routing functions in each switch. Assume also that the new routing function lets all packets travel vertically first, and then horizontally. In an uncontrolled sequence of events, we may end up in a situation as illustrated in below figure 2. Here all ports of the upper right switch and the lower left switch have started using the new routing function. They have also started to forward packets according to the new routing function. The other two switches still forward packets according to the old routing function. The prevailing routing strategy of the switches at this point is to use the clockwise direction for all data packets whose destination is diagonally opposite. Figure 2 shows that CN1 has sent grey data packets 15, filling up the buffers of the upper horizontal channel, CN2 has sent blue data packets 25 filling up the buffers of the rightmost vertical channel etc. It is also noted that in this situation, no data packets can proceed any further to their destination, because all "next-hop" buffers are already full. This is what is called a network deadlock in the present application. It is further noted that if a switch was allowed to throw away packets, as would be the case in a typical application area of the Khosravis patent, the deadlock could be resolved; however, it is not the case of the present invention.

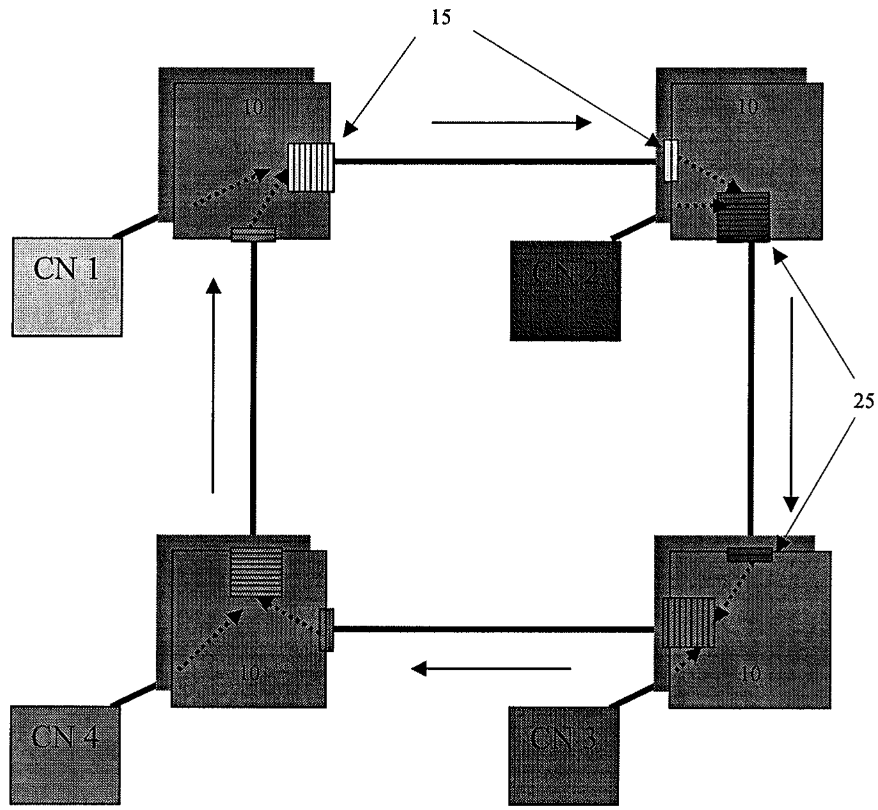

Fig. 2

Accordingly, in view of above explanation of the network deadlock, it is noted that it is important for the present invention to control *when* packet transfer between the plurality of ports happen in order to guarantee the reconfiguration of the routing function in a deadlock free manner. In other words, that's why the present invention provides that *the transitioning of the network routing function is* ***controlled by means of tokens*** *defining said second routing function* R_{new} *to be used by each network element in the network to ensure that forwarding of data packets in the network elements in said network will not be halted indefinitely when altering the network routing function, where said method when applied to a network with link-level flow control will not create network deadlock* as recited in claim 1. Applicants respectfully submit that this feature is clearly absent from Khosravis, and also Khosravis fails to teach or suggest each and every step

as recited in claim 1 to accomplish the above-mentioned feature. Therefore, claim 1 clearly defines over the teachings of the references relied on by the Examiner.

In addition, claims 2-13 depend, either directly or indirectly, from independent claim 1, and are therefore allowable based on their respective dependence from independent claim 1, which is believed to be allowable.

In view of the above amendments to the claims and remarks, Applicant respectfully submits that claims 1-13 clearly define the present invention over the references relied on by the Examiner. Accordingly, reconsideration and withdrawal of the rejections under 35 U.S.C. §§ 102 and 103 are respectfully requested.

CONCLUSION

It is believed that a full and complete response has been made to the Office Action, and that as such, the Examiner is respectfully requested to send the application to Issue.

In the event there are any matters remaining in this application, the Examiner is invited to contact Paul C. Lewis, Registration No. 43,368 at (703) 205-8000 in the Washington, D.C. area.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§ 1.16 or 1.147; particularly, extension of time fees.

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Respectfully submitted,

By

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